What is Claimed Is:

1. An imaging module for use in a system implementing a machine vision application, the imaging module comprising:

an image sensor, for imaging a field of view encompassing a target subject of the machine vision application and generating representative image data;

a processor, coupled to receive the image data from the image sensor, for calculating gradient information from the image data; and

a data communication interface for transmitting the gradient information from the processor to a host implementing the machine vision application.

2. The imaging module of claim 1, wherein the processor comprises pipelined image processing circuitry.

3. The imaging module of claim 2, wherein the pipelined image processing circuitry comprises a filed programmable gate array (FPGA), which can be dynamically reconfigured to meet alternate image processing requirements..

4. The imaging module of claim 1, further comprising a control coupled to the image sensor, the processor and the data communication interface for controlling operations of the module.

5. The imaging module of claim 4, further comprising an illumination source coupled for selective activation by the control, for illuminating the target.

6. The imaging module of claim 5, wherein the illumination source comprises a strobe comprising a light-emitting-diode (LED) array.

7. An imaging module for use in a system implementing a machine vision application, the imaging module comprising:

an image sensor, for imaging a field of view encompassing a target subject of the machine vision application and generating representative image data;

a processor, coupled to receive the image data from the image sensor, for performing at least one of a background subtraction and a gradient calculation on the image data from the image

sensor, to form pre-processed image information and for compressing the pre-processed image information; and

a data communication interface for transmitting the compressed pre-processed image information from the processor to a host implementing the machine vision application.

8. The imaging module of claim 7, wherein the processor comprises pipelined image processing circuitry.

9. The imaging module of claim 8, wherein the pipelined image processing circuitry comprises a filed programmable gate array (FPGA).

10. The imaging module of claim 8, wherein the pipelined image processing circuitry performs a background image subtraction, calculates a gradient magnitude for each respective pixel of data from a result of the background image subtraction to produce gradient information, and performs run length encoding (RLE) on the gradient information to form the compressed pre-processed image information.

11. The imaging module of claim 10, wherein the pipelined image processing circuitry also performs at least one threshold operation to remove data below a threshold value.

12. The imaging module of claim 10, further comprising a control coupled to the image sensor, the processor and the data communication interface for controlling operations of the module.

13. The imaging module of claim 12, further comprising an illumination source coupled for selective activation by the control, for illuminating the target.

14. The imaging module of claim 13, wherein the illumination source comprises a strobe comprising a light emitting diode (LED) array.

15. The imaging module of claim 13, wherein:

the control selectively activates the image sensor to generate data representing a background image without illumination by the source and to generate data representing a foreground image of the field of view illuminated by the source; and

the processor performs the background subtraction by subtracting the data representing the background image without illumination from the data representing the illuminated foreground image.

16. A wheel alignment system, comprising:

at least one imaging module, comprising:

1) an image sensor, for imaging a field of view encompassing at least one target mounted on a wheel of a subject vehicle and generating image data representing the imaged field of view;
2) a processor, coupled to receive the image data from the image sensor, for performing at least one of a background subtraction and a gradient calculation on information from the image data from the image sensor, to form pre-processed image information; and
3) a data communication interface for transmitting the pre-processed image information from the processor; and

a host computer coupled to receive the pre-processed image information transmitted from the at least one imaging module, for processing the pre-processed image information to determine at least one wheel alignment parameter of the vehicle.

17. The wheel alignment system of claim 16, wherein the processor compresses the pre-processed image information, and the data communication interface transmits the pre-processed image information to the host computer in compressed form.

18. The wheel alignment system of claim 16, wherein the processor performs both a background subtraction on the image data from the image sensor and a gradient calculation based on a result of the background subtraction, to form the pre-processed image information.

19. The wheel alignment system of claim 18, wherein the processor compresses the pre-processed image information, and the data communication interface transmits the pre-processed image information to the host computer in compressed form.

20. The wheel alignment system of claim 18, further comprising a strobe for selectively illuminating the at least one optical target when mounted on a vehicle, wherein:

the image sensor selectively images the field of view encompassing the at least one target and generates data representing a background image without illumination from the strobe and generates data representing a foreground image containing the at least one target illuminated by the strobe; and

the processor performs a background subtraction by subtracting the data representing the background image without illumination from the data representing the illuminated foreground image.

21. A method of image processing, for a machine vision application, comprising:

capturing an image of a field of view encompassing a target subject of the machine vision application;

generating image data representing the captured image;

calculating gradient information from the image data; and

transmitting the gradient information to a host processor implementing the machine vision application.

22. The method of claim 21, wherein transmitting the gradient information comprises:

compressing the gradient information; and

transmitting the compressed gradient information to the host processor.

23. The method of claim 21, wherein:

the step of capturing the image comprises:

capturing a background image without illumination;

illuminating the field of view encompassing the target subject of the machine vision application; and

forming a foreground image of the illuminated field of view;

the step of generating image data comprises:

generating image data representing the background image without illumination;

generating image data representing the illuminated foreground image of the target subject; and

subtracting the data representing the background image without illumination from the data representing the illuminated foreground image of the target subject; and

the step of calculating gradient information is responsive to a result of the subtracting step.

24. The method of claim 23, wherein the step of transmitting the gradient information comprises:

compressing the gradient information; and

transmitting the compressed gradient information to the host processor.

25. The method of claim 21, wherein the machine vision application comprises an alignment measurement of one or more wheels of a vehicle, and the target subject comprises one or more visible targets mounted on the one or more wheels of the vehicle.

26. The method of claim 25, further comprising:

receiving the gradient information in the host processing system;

processing the received gradient information to derive positional data regarding position of the one or more visible targets; and

processing the positional data, in the host processing system, to determine at least one wheel alignment parameter of the vehicle.

27. A method of image processing, for a machine vision application, comprising:

capturing a background image without illumination;

generating image data representing the background image;

illuminating a field of view including a target subject of the machine vision application;

forming a foreground image of the illuminated field of view;

generating image data representing the illuminated foreground image; and

subtracting data representing the background image from the data representing the foreground image; and

compressing a result of the subtracting step to form compressed image information; and

transmitting the compressed image information to a host processor implementing the machine vision application.

28. The method of claim 27, further comprising

calculating gradient information from a result of the subtracting step;

wherein the step of compressing comprises compressing the gradient information.

29. The method of claim 27, wherein the machine vision application comprises an alignment measurement of one or more wheels of a vehicle, and the target subject comprises one or more visible targets mounted on the one or more wheels of the vehicle.

30. The method of claim 29, further comprising:

receiving the compressed image information in the host processing system;

processing the received compressed image information to derive positional data regarding position of the one or more visible targets; and

processing the positional data, in the host processing system, to determine at least one wheel alignment parameter of the vehicle.

31. A method of determining a wheel alignment parameter of a vehicle, comprising:

attaching a plurality of targets on respective wheels of the vehicle, each attached target comprising at least one visually perceptible target element;

using a camera to capture a background image;

illuminating the targets;

using the camera to view the illuminated targets, to form a foreground image thereof and to generate foreground image data from the foreground image;

subtracting data regarding the background image from the foreground image data;

in response to the subtracting step, calculating gradient information;

compressing the gradient information;

transmitting the compressed gradient information to a host processing system;

in the host processing system, processing the compressed gradient information to derive positional data regarding positions of the at least one target element of the attached targets; and

in the host processing system, processing the positional data to determine the wheel alignment parameter of the vehicle.

32. In a wheel alignment system having an image sensing module and a host processor for calculating a vehicle wheel alignment parameter in response to image data communicated from the image sensing module, an improvement in the image sensing module, wherein the image sensing module comprises:

an image sensor circuit for capturing and digitizing images;

a field programmable gate array coupled to the image sensor circuit for pre-processing the digitized images; and

a communication interface coupled to the field programmable gate array for sending pre-processed image data to the host processor.

33. The improvement as in claim 32, wherein the communication interface comprises a USB interface.

34. The improvement as in claim 33, further comprising a controller coupled to the image sensor circuit and the field programmable gate array, for controlling operation of the image sensing module.

35. The improvement of claim 34, wherein the controller and the USB interface are constructed as an integral unit.

36. In a wheel alignment system having an image sensing module and a host processor for calculating a vehicle wheel alignment parameter in response to image data communicated from the image sensing module, an improvement in the image sensing module, wherein the image sensing module comprises:

an image sensor circuit for capturing and digitizing images;

a communication interface for sending digitized image data to the host processor; and

an active electronic cooling circuit arranged to cool at least the image sensor circuit.

37. The improvement of claim 36, wherein the active electronic cooling circuit comprises:

a temperature sensor; and

a Peltier device or thermoelectric cooler.

38. In a wheel alignment system having an image sensing module and a host processor for calculating a vehicle wheel alignment parameter in response to image data communicated from the image sensing module, an improvement in the image sensing module, wherein the image sensing module comprises:

an image sensor circuit, for capturing and digitizing images;

an electronic strobe circuit, for illuminating a field of view for imaging by the image sensor circuit;

a controller circuit coupled to the image sensor circuit and the electronic strobe circuit;

a communication interface circuit, for sending digitized image data to the host processor; and

at least one optical isolator coupled to the electronic strobe circuit, for optically isolating the strobe circuit from the other circuits of the image sensing module.